

An overview on the additives used in improvement of dough flow behaving characteristics

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Summary. Bread in all its diversity has cited as an ancient foodstuff for over 6000 years; bread dough, due to its viscoelastic behavior may consider as the most complicated rheological system, which highly effects on final products' sensorial and textural properties. Since the research dough rheology is of being challenging issues, therefore this explains why dough rheology has been an attractive title for several decades. Recently, demand to use new formula and sources such as cassava which result in enhancement of digestibility and along with it, the incorporation of previously mentioned sources in cereal products, has been converted to a growingly investigation of rheological properties of dough. Substitution level of any novel sources directly effects on texture properties, even adverse affections, which evaluates by panelists therefore in this review we focus on different concepts of bread rheology and the affection of all added ingredients on physiochemical properties.

Keywords: food rheology, bread, physiochemical properties, organoleptic properties, sensory evaluation

Introduction

Depending on the regions human being is living, a range of cereals consider as the most used one and therefore climatic conditions, growth process and the type of soil even effect on the quality of their products (Taketa *et al.*, 2004). Considering bread as a widely consuming commodities in many nations, the role of additives in technological improving along with concerns related to its quality and sustainability are issues which makes bread so determinative and important in dietetic (Goesaert *et al.*, 2008).

Among bakery products, bread is a high demand commodities find in families' food baskets, therefore the possible risks may transmit when distributing this kind of products is of course, a concern for nutritionist. With regards to the fact that enriching is targeting healthier diet (Wood, 2002; Izydorczyk *et al.*, 2001), addition of compounds such as β -glucan, fibers (soluble and insoluble dietary fibers (Hadfield and Bennett, 1998; Meuser *et al.*, 1994; Cummings, 1994) and other cereals flours as well as gums (Gómez-Díaz and Navaza, 2003) namely alginate, carrageenan etc (Rosell *et al.*, 2001) to the wheat dough is of interest (Straumite *et al.*, 2010; Raninen *et al.*, 2010). Mainly, addition of an ingredient to bread formula is performed with aiming at functions like oil uptake (Albert and Mittal, 2002; Lucca and Tepper, 1994), increase nutritional value, extending shelf life and shelf stability and diminishes the incidence of diseases e.g. gastrointestinal and fibers are of such those compounds (Park *et al.*,

1997; Anderson *et al.*, 2009; Figuerola *et al.*, 2005; Rosell *et al.*, 2001; Gurkin, 2002).

It must be noted that subjecting of compounds to mechanical and heat treatments during baking cause to some changes in additives nature, (Collar and Armero, 1996; Létang *et al.*, 1999; Rosell *et al.*, 2007; Moreira *et al.*, 2010) effecting final product in terms of flavor and rheological properties which is routinely a technical issue (Katina *et al.*, 2006). Rheology of each fluid or semi fluid food product plays an important role in quality of it (Bloksma, 1990). To produce dough, some ingredients incorporate with each other consisting of water, salt, flour, additives. The role of each ingredient in bread formula can be explained; water as the main liquid of formula plasticize dough and helps to its extension (Belton, 2003). The percent water absorption increased significantly with the addition of surfactants (monodiglyceride and lecithin) alone or in combination. Moreover, the overall dough rheological characteristics and baking quality improved and further these surfactants retarded the rate of staling in bread (Azizi *et al.*, 2003). The role of salt imperceptibly affects via affection of hydrogen bonds and cohesiveness of system (Eliasson and Larsson, 1993). The fact that more salt can bond with more water molecules, it can imply that gluten strength will increase (Preston, 1985; Ghadami *et al.*, 2014). Either main bread base compounds or additives have their priorities and limitations in creating targeted properties. Additives will discuss in details as below;

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Dietary fibers

Fibers contain some sub structures including lignin, cellulose, pectin and carbohydrates components (e.g. modified cellulose, derivate fibers from cereals or fruits, inulin and guar) (Elleuch *et al.*, 2011; Sudha *et al.*, 2007; Zhang and Moore, 1997; Gomez *et al.*, 2003; Wang *et al.*, 2002). Psyllium seed is a source of dietary fiber from Plantago genus by its incorporation cholesterol levels are reduced (Cummings, 1993; Anderson *et al.*, 2000).

Non starch polymers such as pentosen (Izydorczyk *et al.*, 2003) are important owing to its functional properties such as the role of them in cell wall against other harmful microorganisms (Maes and Delcour, 2002).

Another group of hydrocolloids is so-called Gums whose affections are different on dough quality; for instance locust bean gives water holding property and increase softness of dough, or in case of xanthan and alginate hindering some gluten-protein interactions leading to modification in technical properties of dough (Rao *et al.*, 2000).

β -glucan can create high viscous dough (Delcour *et al.*, 1991; Wang *et al.*, 1998). Some other sources of ingredients and additives can be classed as non-wheat flour (Gandhi *et al.*, 2001 and Sharma and Chauhan, 2002) owing to their dietary fibers. Production of flour can be from grains like wheat, rye, maize & roots like cassava in order to enrich wheat flour (Spiekermann, 2006; Ekop *et al.*, 2007; Lin *et al.*, 2009).

These additives also give their rheological properties (Oluwole *et al.*, 2006). furthermore, Oyster mushroom, a source of dietary fiber both soluble and insoluble mainly B glucan (Fahmey *et al.*, 1981; Ulloa *et al.*, 1988; Varughese, *et al.*, 1996; Petrovska *et al.*, 2002), therefore increases population public health from the viewpoint of nutritional (Autio *et al.*, 1998). Enriching with amino acids also studied by Stark *et al.* (1975) and Hoover. (1979).

Reducing and oxidizing agents

Both additives of interchanging and improving s-s bonds affecting on the final strength of dough (Eliasson and Larsson, 1993, Wrigley *et al.*, 1998). Concerning the type and variety of wheat, it must note that their physiological and theological properties can have far reaching influences on the final dough. Improvers, mainly oxidizers and reducers 2,3, are a group of additives targeting on ehnacing the bread qualities in stages like fermentation, baking and etc.

Proteins

Gluten is rich in gliadins and glutenins. Protein-starch interactions mostly comes from Gluten which is composed of gliadins(prolamines); responsible for plasticity and glutenins (glutelins); responsible for elasticity.

Dynamic rheological parameters of glutens are able to indicate the wheat quality. Glutens from poor quality reconstituted using glutens of different wheat cultivars and a content source of starch and water

soluble (Khatkar and Schofield, 2002). Protein effects on increasing of water affection (Hefnawy *et al.*, 2012).

Commonly, the quality and quantity of proteins consider as critical parameter in determining flour quality grade but starch is more important (Lindahl and Eliasson, 1986). Due to unique structure of peptide connected amino acids in polymer chains, they play role in flavor, structure and texture of foodstuffs. Dough is a complex, nonlinear set with time dependent viscoelastic system (Mani *et al.*, 1992). Viscoelastic behavior of dough contains completely viscous liquid and complete elastic solid properties (Lindahl, L., A. C. Elisson, 1992). Primarily, nonfat dry milk powder was added to dough due to as bellows;

Increase of water uptake capacity in dough, enhancing the body properties of bread dough, consistency and modification of dough, improving bread color as a result of lactose (dry milk contains 52%) presence in browning reaction, reduction of staling rate.

Enriched lysine materials such as beans are a superior in fortifying bread in developing countries where lack of sufficient wheat source has led to importing this necessity good. Addition of cowpea flour increase the level of water uptake in wheat flour may lead to starch broken up in baking stage (Hallen *et al.*, 2004). Cohesiveness of dough only is just influenced by soybean protein (Marco and Rosell, 2008). Legumes such as soybean and chickpea are active in emulsifying properties and its stability (Tömösközi *et al.*, 2001).

Since dairy proteins such as whey proteins can be used as a protein source in dough. it has been also studied in details e.g. 4% of sodium caseinate reduce extensibility compared to whey protein concentration which increase this characteristic (Kenny *et al.*, 2001; Rostami *et al.*, 2012). Addition of dairy products also enhances the mouth feel viscoelasticity of dough and overall properties of dough (Ahlborn *et al.*, 2005; Gallagher *et al.*, 2004; Moore *et al.*, 2006; Schober *et al.*, 2005).

Starch

After cellulose, the most occurring carbohydrate is starch which present mostly in endosperm (Kulp, 1972). Starch, due to retrogradation properties, is the reason of staling in texture. Indeed, the non-crystal part of starch which so called amylose is responsible for staling. Depending on the type of mixing material, some different physiochemical and microbiological phenomenon occur in kneading stage. The process of bread making is started by mixing continued by development stage in which manifestation of elasticity introduced via appearing a smoothly surface due to removing of water from surface.

Humectants

The role of some additives is to ehnace machining properties and texture of breads (Ribotta *et al.*, 2008; Barcenas and Rosell, 2006, 2007; Azizi *et al.*, 2003; Caballero *et al.*, 2007).

Due to hygroscopic properties of humectants such as sorbitol, Glycerin etc, they have the capability of controlling aquatic systems in dough structure.

Fat replacer

The most challenging part of using fat replacer is their possibility embodying dough, mouth feel and other desirable rheological properties.

Fat replacers such as maltodextrins, with no side effects, create lubricant properties of dough (Yackel and Cox, 1992). Polyxdestroe participates in mouth feel and creaminess properties (Mitchell, 1996). Some other fat replacers are inulin and Simplese effects on modulus of dough. (O'Brien *et al.*, 2003). Fat replacers such as maltodextrins, with no side effects, create lubricant properties of dough (Yackel & Cox, 1992). Polyxdestroe participates in mouth feel and creaminess properties (Mitchell, 1996).

Enzymes

Enzymes are used in baking to improve dough handling properties and the quality of baked

products. Double sulfide cross-linked affecting enzymes like Glucose oxidase are additives to consider far reaching effects in different level of additions on final dough rheological properties; for instance in high levels (Bonet *et al.*, 2006).

Conclusion

Regarding the quality and quantity of each additive it must be noted that a wide range of compounds are available which has to be studied in details from not only the viewpoint of technically but deforming potentials of them. To date, addition of many additives to dough behavior characteristics have studied. But still more studies need to appear the microstructure, macrostructure, interactions even chemical and physical phenomenon.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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